



Garage Parking Automation System

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Abstract: Metropolitan cities in India are getting more and more populated leading to a lot of traffic and this traffic gets worst when there is no proper parking space available. The current scenario of parking in most cities is chaotic. Most of the parking in manually handled and hence lack proper management and structure. Some parking spaces are computerized but they are not reliable and inefficient. The situation of parking get extremely chaotic at peak hours, at times it happens that even with ample space the parking space is not fully utilized. Customers are confused in search of parking space which is not known to them. All these inefficiency and confusion leads to loss of the Parking space owner. In this project, we propose a fully computerized well managed and efficient system to solve all the problems pestering the current parking scenario. Online reservation is provided so that customers can register and reserve parking space beforehand. Proper management for on spot customers who have not reserved parking spaces is provided manually. All the parking spots are well organized with numbers and installed with spot sensors. Efficient algorithms are used to schedule the parking space and provide shortest distance from the entry gate to parking spot to the customers hence increasing the efficiency of the whole system. The Projects makes the complete parking scenario well organized, sophisticated and highly efficient.

Keywords: Parking; Garage; Automatic Parking; Computerized Parking.

I. INTRODUCTION

The current situation of parking is very much unorganized and unplanned which leads to a lot of difficulties for customers and parking space owners. So this project aims to design a new innovative, highly efficient, sophisticated way to solve the problem of parking in metropolitan cities of India. In the current scenario, the garage parking is not equipped with good and planned computerized system. Also in the current parking system the customers have to walk around the garage looking for free parking spots. The congestion and confusion inside the garage is very frequent. The parking system used is not well managed and also not well designed. During peak hours the garage may or may not have free spots but the system provides no way of checking it instantly. All these problems discourage customers to park in the garage and hence creating traffic jams on roads. The garage owners are being robbed of additional income and they are in loss. The project takes note of all the problems in the current parking situation to design a completely new innovative computerized parking system. The project involves implementation of design into software with hardware installed in the garage that would increase the efficiency and thereby profit of the garage owners.

The project aims towards designing a new system which will include a website supported on any web based browser including PC and mobile devices that will allow customers to register and place online reservations for parking space. The reservation would include date, time and duration of stay. The customer can register their vehicle by putting the vehicle's license plate number. Multiple vehicles can also be registered. On spot reservations are also supported which can be done manually by checking for free spots from the server. All the reservations are scheduled using an algorithm. The customers are provided shortest path from the elevator gate to parking spot using Breadth First Search Algorithm. This feature makes the system user friendly and efficient.

II. RELATED WORK

Garage parking has always been an important topic for research so as to make parking more systematic and organized. A number of research papers have been published in the field. In 1995, a paper presented in Vehicle Navigation and Information System Conference used the vehicle sensors like infrared or other sensors at each parking space to detect and keep track of the exact locations of the empty parking spaces [1].

Wolff et al used completely new and innovative magnetic field sensor and wired based technology to test on their conceptual simulation of car park model [2].

Parking systems which are developed and currently in use at Shinjuku, Japan [3] and new innovative parking system of Tapiola, Finland [4] are examples of systems which are designed and developed to help and guide the customers in finding vacant car parking space.

Intelligent and Smart parking system project which work on and use the concept of vision based systems [5] increase efficiency of the system with their smart vision based algorithms.

All these parking system are good to go. They are smart, robust, and efficient but they lack some important aspect of parking when facing real life constraints of reservation and parking systems. These constraints if not dealt with properly and efficiently, a lot of times create problems.

A lot of time customers don't know if they will get a parking space at peak time. The project designs a system which uses online reservation to solve the problem of prior reservations, it efficiently solves the problem in which user is definite that he/she will definitely find a place to park given the fact they have to specify the time of arrival and other stats. If a customer doesn't have prior reservation then he/she can get parking space by using manual on-spot parking.

Munich Airport [6] uses online reservation to provide prior reservations but still at peak hours the parking space gets chaotic cause all the customers are looking for their parking space. But in this project, highly planned technique is used which provide parking at number of floors and the shortest distance for parking. Also we use the ground floor for unreserved customers so as to make the parking as easy as possible.

There are a lot of Parking lots which use radio frequency identification (RFID) and smart card technology [7, 8]. In this a tag is provided which is installed with code and the same code is assigned to the car. When the data is read from the RFID tag it is send to the microcontroller. By matching both the codes it keeps the track of vacancies and available parking space in the garage.

These projects are efficient but it takes some time to read the smart cards and process the data, so we use a camera sensor which directly takes the number from the user's car as input and process it. Now at times the number plate may not be clear then the input can be taken manually.

III. PROPOSED SOLUTION

Metropolitan cities in India boast huge traffic and in market places it gets very difficult to accommodate this huge traffic due to lack of parking space and this leads to dead end traffic jams. So the solution to this problem is to provide multi-storey parking space. Although there are number of multi-storey parking already constructed but they are not well managed and lack computerized system which leads to loss of profit to the parking owner. This problem can be solved by providing a well-managed computerized multi-storey parking.

Already developed multi-storey parking face the problem of congestion inside the garage at peak time as customers don't know about the available parking space inside the garage and also if space is available then there is no way to know that in which part of garage parking space is available. This leads to a lot of congestion and confusion inside the garage due to which some customers will avoid the idea to park inside the garage leading to less profit to the garage owner. This problem can be solved by installing a spot sensor at each parking space inside the garage and number them. Later on provide parking space numbers corresponding to these spot sensors to the customers. This way the customer knows where he has to park without any confusion and congestion.

Providing a web based system to manage the garage can make the parking system very much efficient and profitable. This system will allow customers to book reservations online beforehand by choosing date and time.

IV. METHODOLOGY

A. Process Model Description

The spiral software lifecycle model is extended so that it can address and solve new problems and challenges, such as coping and addressing the problem of rapid change in the product development while simultaneously assuring high dependability. A hybrid model which is plan-driven and agile has been outlined in a perfect way to address these conflicting challenges or problems with the need to rapidly field incremental capabilities.

Here, the spiral model is taken as the base model and it is intermixed with incremental model to develop a new hybrid

model, as shown in Fig.1. This strategy is very helpful for a efficient software development. We use the incremental model to add new features whenever we want in the system, it gives a high reliability and makes the system and software capable of accepting new changes and features. The spiral model plays a vital role in initial development of the project and helps in keeping track of risk factors but adding new features to the product is difficult while using spiral model so we hybrid it with incremental model which makes adding new features to the product a lot more easier. So this hybrid model adds extra features to existing Software Development Cycle like strengthening the risk identification and management, increasing the scalability of the project, easier to add new features to the project as the market and demand changes.

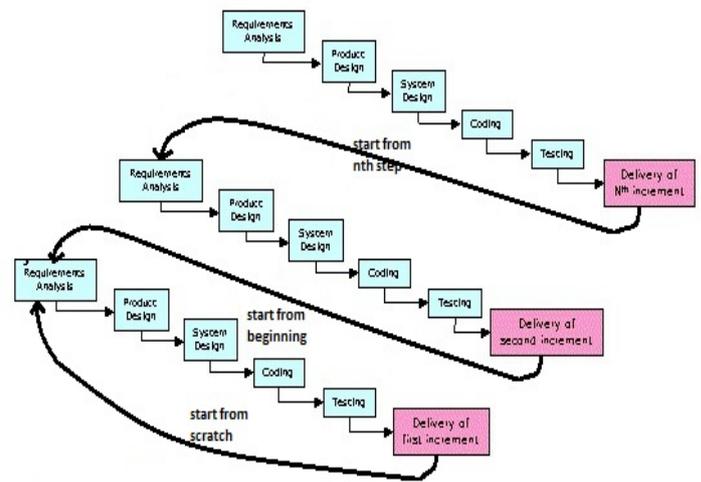


Figure 1. Hybrid of Spiral and Incremental model

B. Use Case Documentation



Figure 2. Use Case Model

- **Reserve:** This use case describes how to reserve a spot for vehicle parking. It can be done online using website or on-spot if there is free spot for parking at current time.
- **Register:** New customer registers on the website by filling the details. After registering the customer is eligible to avail online reservations.
- **Park:** This use case allows the customer to park their vehicle in the garage.
- **Authenticate user:** To be positively identified by the system.
- **Manage Account:** To edit the details of customer's account.
- **View reservation:** To view existing reservations and edit any reservations.
- **Register vehicle:** To register a new vehicle by providing relevant details like vehicle type, vehicle number etc
- **Manage garage:** The system admin uses this use case to set parking prices or inspect usage history.
- **Edit Reservation:** The customer can use this to edit reservation already made.
- **Edit vehicle:** To edit the details of the vehicle already registered.

- **Set prices:** To set the parking prices and penalty fees for a particular garage.
- **Monthly billing:** To generate and send a monthly bill to every registered customer in the database.
- **Inspect usage history:** To examine the usage history of a particular garage.

C. Project Architecture

The project requires a number of hardware components which needs to be installed for proper working of the project. The hardware components are as follows:

- **Cameras:** The system requires camera to get the registration number of vehicle from the vehicle number plate and also records the time when the customer vehicle leaves the garage.
- **Elevator Display:** The elevator display shows the customer's registration, parking spot and shortest distance to reach the parking spot from the elevator.
- **Elevator Keypad:** The elevator keypad consists of numbers, delete and enter button. The customer can feed his customer ID to get information about parking.
- **On-spot parking computer:** This is for unregistered customers who can avail parking manually. It is operated by system admin.
- **Spot sensors:** An ultrasonic sensor which detects the vacancy of a spot in the garage.
- **Web client:** Any web or mobile browser through which the customer can register himself and make reservations.

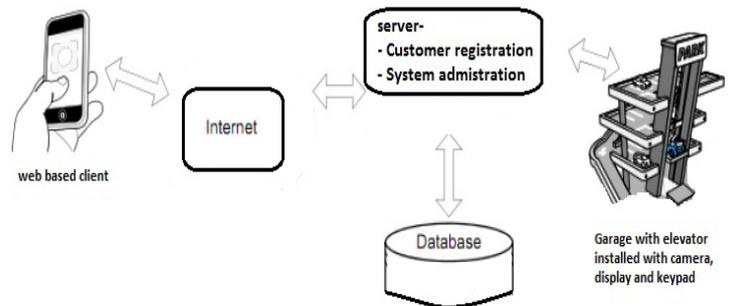


Figure 3. Project Architecture

The system architecture will have following design specification:

- A database which contains all data about the customers, vehicles, reservations etc.
- A system administrator who can set prices for parking, view registered customers and their data statistics.
- The customer will make reservation by selecting date and time; if the reservation slot is available the parking is reserved for the customer. If customer wants he has option to edit his existing reservations but it should be done no later than 1 hour before the start time.
- The customer gets a spot number generated by the system which can be used to find the parking spot in the garage.

- When the customer arrives at the garage the camera recognition system analyzes the vehicle plate number and finds the reservation for the customer from database.
- If the customer is not registered and he wants on-spot parking, the system assigns him a parking spot if any parking space is available by checking the database. This process can be done manually by admin.
- If the camera cannot recognize the plate registration number, the customer can login using unique customer id from the keypad installed in the elevator. The screen installed in the elevator will show his parking spot with number by extracting from the database.
- The screen installed in the elevator will also show the shortest path from the lift to the parking spot which customer can use to find his parking spot efficiently and without any confusion.
- If the customer uses a smart phone with internet access he can use this whole system on his mobile phone making the task a lot easier and sophisticated.

D. Software Architecture

The project is hardware designed which is implemented using software. The software part consist of web based client and a server consisting of database. The software can be designed using HTML, CSS and JavaScript. The backend is implemented using PHP with MYSQL connectivity with Database. The tasks performed by the software are as follows:

- Customer registration
- Vehicle registration
- Parking reservation
- Bill payment
- Admin Management of the reservations

There are two important algorithms used in the project. They are eventually backbone of the project.

- 1) *Scheduling reservation*: The system uses an algorithm designed specifically to assign parking spots to the customer. It avoids deadlocks in parking and makes the system efficient by utilizing every space possible in the garage. The implementation of the algorithm is as follows:

Consider a matrix M[spot number, time period]
 Time period is taken as time block (consider 1 hour increment). Let 'Rserv' be unique reservation of a vehicle having start time and end time and 'total_spots' be the maximum number of parking spots. 'Rserv' is assigned a unique number. The input to the algorithm include matrix M, Rsev, total_spot and it produces matrix M after adding new reservation 'Rsev'.

```
function Reserve(M,Rsev,total_spots) //to assign reserved=false;
for each spot number S1 in M until reserved= true
    if spot number S1 is available
        from Rsev.start to Rsev.end then
            assign Rsev to spot number S1;
            reserve=true;
if reserve=false then
    if size M=total_spots
```

```
        return Swap_reservation(M,Rserv);
else
    return M;
```

Swap_reservation(M,R)

For each spot number S1 in M

If S1 is available at Rserv.start but not Rserv.end then

Rserv1=S.nextReservation;

For each spot number S2 not considered in M

Rsev2=S2.nextReservation

if S2 is free from Rerv1.start

until Rserv2.end and

S1 is free from Rserv1.end

and Rserv2.end then

swap Rserv1 with Rserv2;

Reserve Rserv to spot number S1

- 2) *Shortest distance from Elevator to Parking spot*:

If several spots are available for parking then this algorithm finds the parking spot with shortest distance from the elevator. It increases the efficiency of the system. The system uses Breadth First Search (BFS) Algorithm [9] to find a shortest distance from Elevator to Parking spot. It takes the elevator and other parking spots as nodes and then using the algorithm to find the shortest path. The shortest path is displayed on the elevator display. The user can use the shortest path to find his parking spot without any discrepancy and confusion.

V. CONCLUSION

The project is hardware designed model implemented using software. Most important aspect of the project is compatibility between hardware and software. A number of problems were faced in increasing the efficiency and compatibility of the system. The project pin points the problems faced in parking systems and then uses software engineering to solve them. The software deployed on web portal makes the parking scenario sophisticated and efficient for the customer. The hardware components installed in the garage makes the task of garage owners a lot easier, fast and robust. The project can be further extended to develop smart phone applications which can be installed on mobile phones by customers. Mobile applications are a lot more fast and robust as compared to web applications. If the project is implemented and deployed in the Indian garage parking scenario it will definitely solve a lot of problems in parking and traffic management, if the project is successful at small scale it can be further extended and a universal portal can be deployed for parking where all the garage and parking space owners around the country can register and use the product.

VI. REFERENCES

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